~~SPECIFICATION~~

~~PROCEDURE FOR A MOBILE UNIT TO LOG IN WITH A BASE STATION, AND COMMUNICATION SYSTEM~~

The invention is directed to a method for logging a mobile ~~part on~~ at a base station and is also directed to a communication system. The invention is particularly employable for telephone systems having at least one mobile part and at least one base station. The mobile part can thereby be a cordless telephone, particularly an analog telephone to ~~CT0 standard.~~ The invention, however, can also be employed in other communication systems wherein a dependable allocation between mobile parts and base stations is required, ~~for example~~ for remote controls of all types.

It ~~can~~ be necessary in a telephone system to log a cordless telephone ~~on~~ at a base station and to thus register it. This, for example, is the case in what are referred to as concentrator systems, wherein a plurality of mobile ~~parts~~ can be operated parallel (without the possibility of internal connections) at a base station. ~~For setting~~ up such a system, a plurality of mobile ~~parts~~ must be allocated to the base station, and it is desirable for later expansion to also be able to log new mobile ~~parts on~~ at the base station.

In telephone systems that are only composed of a single base station ~~in~~ a single mobile ~~part~~, as well, the possibility of flexible log on is desirable. As a result thereof, the production of the telephone system is facilitated because no consideration must be given to a paired allocation of mobile ~~part~~ and base station. Further, a lost or malfunctioning mobile ~~part~~ can simply be replaced by a new one in this case.

U.S. Patent No. ~~US~~ 5,500,888 discloses a cordless telephone that comprises a means for enhancing the security of the cordless telephone with respect to unauthorized use of the telephone and with respect to unauthorized tapping. To this end, this means is fashioned such that a security code is stored in the mobile ~~part~~ and the base station upon initial commissioning of the telephone and ~~such that~~ this stored security code is automatically modified every time ~~when~~ the mobile ~~part~~ is located on the base station for charging the battery. This modification of the code ~~ensues in that~~ is effected by generating a new code ~~is generated~~ from a random number in the mobile ~~part~~ or the base station, ~~this~~

transmitting the new code

~~new code is transmitted~~ via the radio interface of the telephone to the respective ~~respectively~~ other side, and ~~the~~ acknowledging transmission of the code ~~is acknowledge~~ to the code sender by the code receiver via the radio interface.

U.S. Patent no

~~US~~ 4,736,404 discloses a cordless telephone that comprises a means for enhancing the security of the cordless telephone with respect to unauthorized use of the telephone. To this end, this means is fashioned such that a security code is compared before telephoning ~~can be~~ carried ~~with~~ the mobile ~~part~~ unit of the telephone via the base station. When the comparison shows that the ~~code coincides~~ codes coincide, then telephoning can be carried out with the mobile ~~part; otherwise~~ unit otherwise, the mobile ~~part~~ unit is rejected as unauthorized. For preparation of the code comparison, a predetermined signal code stored in the base station is communicated from the base station via the charging contacts and the charging line when the mobile ~~part~~ unit is initially located on the base station for charging the battery, and the reception of the signal code is acknowledged to the base station from the mobile ~~part~~ unit.

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The log on of a mobile ~~part~~ unit at a base station is in fact fundamentally possible given known telephone systems according to the CT0 standard; however, complicated authentication routines must be run for this purpose. The reasons for this is that this standard is susceptible to foreign use and what is to be precluded is that, for example, a neighbor logs on at the base station of a user and then telephones at the expense of this user. The authentication routine therefore requires at least the input of a PRN code.

The entire operation is complicated and susceptible to error. Particularly ~~given~~ for simpler devices without a display, the input of a number of numerical codes from a printed operating instruction is required, ~~this, for example, being~~ and, thus, becomes a deterrent for inexperienced users.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to solve ~~said~~ the above described problems and offer a simple and, ~~at the same time~~ yet, dependable possibility for logging a mobile ~~part~~ unit on at a base station that requires outwardly little hardware and software outlay.

~~This object is inventively achieved by a method having the features of claim 1 as well as by a communication system having the features of claim 11.~~

The invention is based on the fundamental idea of transmitting the identifier required for the log on via the ordinary radio connection between the mobile part and the base station and additionally providing a confirmation that is transmitted via a local connection between the mobile part and the base station. What is thereby to be understood by a local connection is any connection that assures spatial proximity between the mobile part and the base station.

The inventive method is dependable due to the use of a local connection, since a mobile part can only be logged on when it is spatially located adequately close to the base station. A neighbor or some other unauthorized person who has no access to the rooms in which the base station is located cannot log a mobile part on. Since the identifier is communicated via the radio connection that already exists between the mobile part and the base station, no additional outlay or only slight additional outlay is required for this purpose. The additional, local connection likewise incurs only slight outlay because only extremely little information need be transmitted over this connection and the simplest embodiments therefore already suffice.

In preferred embodiments, the local connection is an electrical or magnetic or inductive or optical connection. In particular, the local connection can assure a direct or nearly direct contact between the base station and the mobile part. It can be provided, for example, to set the local connection up via the charging contacts that already exist between the mobile part and the base station. The circuit required in this purpose for generating or, respectively, recognizing a confirmation signal is not complicated.

The local connection can be especially simply set up when a binary signal is transmitted thereover. An information set of only one bit is preferably transmitted

via the local connection at every log on event. This suffices for the reliable allocation of base station and mobile part.

Every time the mobile part hangs up, a check is preferably undertaken at the base station to see whether a log on should be undertaken. A re-log on is not required, in particular, when the mobile part is already logged on thereat or at some other base station.

In particular, the identifier serves for the allocation of the mobile part to the base station. In preferred embodiments, the identifier is defined by the mobile part of the base station as a random number. The identifier and/or the confirmation is preferably generated by the mobile part and transmitted therefrom to the base station. In preferred embodiments, the base station receives the identifier and requests the confirmation from the mobile part. A log on is preferably successful when the confirmation signal is generated in a predetermined time window following this request. In further steps, further data, for example log on data, can then be communicated via the radio connection.

• In preferred embodiments, the communication system comprises the features recited above.

An exemplary embodiment of the invention presently preferred by the inventors as well as a plurality of alternative embodiments are explained in greater detail with reference to the schematic drawings. Shown are:

FIG. 1 a block circuit diagram of components of a communication system that are relevant for the invention; and

FIG. 2 a flow chart of a log on method.

The communication system shown in Fig. 1 is an analog telephone system according to CT0 standard having a base station 10 and a mobile part 12 fashioned as cordless telephone. The base station 10 comprises a control means 14 and an analog assembly 16 that are connected to one another as well as to an exchange line 18. An antenna is connected to the analog assembly 16 for sending and receiving radio frequency signals. The control means 14 is connected via a confirmation reception means 22 to a charging contact 24 fashioned as two-pole contact.

The mobile part 12 in turn comprises a control means 26 that is connected to an analog assembly 28 as well as to a confirmation transmission means 30. A loudspeaker 32, a microphone 34 and an antenna 36 are connected to the analog

assembly 28. The confirmation transmission means 30 is in communication with a two-pole charging contact 38.

The telephone system contains further assemblies, for example operating elements, display devices or power supply devices. These assemblies are well known and are not shown in the schematic illustration of Fig. 1

in Fig. 1, the mobile part 12 is placed onto the base station 10 fashioned as charging device, so that the two, respective two-pole charging contacts 24 and 38 are connected to one another. An accumulator of the mobile part 12 (not shown in Fig. 1) is charged via these contacts 24 and 38. When the mobile part 12 is hung up, further, there is a local connection 40 between the two control devices 26 and 14. The local connection 40, which is an electrical line connection here, proceeds from the control means 26 via the confirmation transmission means 30, the two charging contacts 38 and 24 and the confirmation reception means 22 to the control means 14. A confirmation signal can be communicated via the local connection 40 from the mobile part 12 to the base station 10, as described in yet greater detail later.

A call incoming on the exchange line 18 is recognized by the control means 14 and is signaled to the mobile part 12 via a radio connection 42 that proceeds via the analog assembly 16, the antenna 20, the antenna 36 and the analog assembly 28. The base station 10 then sends an identifier identifying the mobile part 12 via the radio connection 42. In a corresponding way, a connection request proceeding from the mobile part 12 is communicated to the base station 10 via the radio connection 42. During a telephone call, further, the radio connection 42 serves as duplex connection for the transmission of the call between the loudspeaker 32 or, respectively, the microphone 34 and the exchange line 18.

The executive sequence shown in Figure 2 begins when the mobile part 12 is placed onto the base station 10. The diagram of Figure 2 is based on a notation similar to the description language SDL. The executive sequence in the base station 10 is shown in the left-hand column, and the executive sequence in the mobile part 12 is shown in right-hand column. The thin, broken-line arrows between the sequence lanes represent communication events via the radio connection 42, whereas the thicker, dot-dash arrow identifies the communication of a confirmation signal via the local connection 40.

Both sequence lanes in Fig. 2 begin with the event HS __ DOWN (events 50 or, respectively, 52). This event indicating when the mobile part 12 is hung up is recognized in the base station 10 and in the mobile part 12 by a respective, suitable circuit that measures the battery charging current flowing via the contacts 24 and 38.

The control means 26 and the mobile part 12 now checks whether a logon of the mobile part 12 is required. A mobile part 12 already logged on at this base station 10 or at some other base station need no longer be logged on again. In the query 54, the mobile part 12 therefore determines whether an identifier for allocation to a base station 10 is already stored in it. When this is the case, a logon is not required, and the mobile part 12 switches into a quiescent condition IDLE (condition 56) in which it is merely supplied with a charging voltage by the base station 10.

When, in contrast, no identifier is stored in the mobile part 12, then a logon is required. This case occurs the first time a new mobile part 12 is placed onto a base station 10. The identifier of a mobile part 12 can also be erased with a suitable command sequence when, for example, the mobile part 12 is to be logged over onto a different base station 10. The logon procedure is also run in this case.

As first step of the actual logon method, the control means 26 of the mobile part 12 generates a new identifier as a 16 bit wide random number (step 58). A 16 bit wide binary counter is provided for this purpose in the control means 26, this being counted up with a predetermined counting rate during the operation of the mobile part 12. This counter is arrested upon recognition of the event 52 (HS __ DOWN), and the counter reading that has been reached serves as provisional identifier that must still be transmitted to the base station 10 and confirmed in the following logon procedure.

In step 60, the mobile part 12 then seeks a free radio channel and continuously transmits a data frame REG __ REQ via the radio connection 42 (transmission event 62) over a predetermined time. The data frame REG _REQ contains the provisional identifier determined in step 58. In the meantime, the base station 10 - in step 64 - searches all available channels (for example 10 or 25 channels) for an incoming data frame REG _ REQ. This channel sweep (scanning) is triggered by the event 50 (HS __ DOWN) in the base station 10.

The base station 10 only implements a predetermined number of complete channel sweeps, for example 2. When no data frame REG __ REQ is received during these channel sweeps, the base station 10 assumes that a logon is not required and that the mobile part 12 is in the quiescent condition 56. The base station 10 then aborts the search and also in turn switches into a quiescent condition.

When, in contrast, the base station 10 has received the data frame REG __ REQ during the search in step 64, then it checks in a query 66 to see whether a further mobile part 12 can be logged on. Each base station 10 can only service a predetermined, maximum number of mobile parts 12, for example 4. When the base station 10 is already fully burdened or denies the logon of the mobile part 12 for some other reasons, it sends a data frame REG __ REJ (transmission event a the radio connection 42 and then switches into a quiescent condition 70. A negative acknowledgment done is triggered at the mobile part 12 as reaction to the data frame REG __ REJ. In response thereto, the mobile part 12 also ends the logon procedure.

When, in contrast, the logon of the mobile part 12 is possible from the point of view of the base station 10, then the base station 10 sends a data frame REG __ VAL ___ REQ (transmission event 72) via the radio connection 42. The data frame REG __ VAL ___ REQ contains the provisional identifier transmitted by the transmission event 62. This data frame represents the request for the mobile part 12 to identify itself with a suitable hardware signal.

As already mentioned, the mobile part 12 continuously sends the data frame REG ___ REQ (transmission event 62) and waits for a reply from the base station 10 in the meantime. When no reply has been received up to the expiration of the predetermined waiting time, a time error (timeout) is triggered in a query 74, and the mobile part 12 switches into a quiescent condition 76. The failure of a reply to arrive can have been caused by a malfunction of the radio connection 42. A further possible reason is that the mobile part 12 has not been placed onto a fully functional base station 10 but only onto a charging dish. In this case, the mobile part 12 nonetheless begins the logon procedure since the event 52 (HS _ DOWN) is recognized on the basis of the battery charging current.

When the mobile part 12 has received the data frame REG __ VAL __REQ within the predetermined time window, then it sends a corresponding confirmation

via the local connection 40 (step 78). This confirmation is the indication that the logon is in fact implemented with the mobile part 12 resting on the base station 10 (and not, for instance, with some other mobile part).

In the exemplary embodiment described here, the confirmation is transmitted as an electrical voltage signal via the charging contacts 24 and 38. The confirmation transmission means 30 offers a suitably modulated signal for this purpose, this differing from the normal charging voltage as well as from signals that can arise given potential incorrect contacts. The confirmation reception means 22 filters such disturbances out and conducts a recognized confirmation signal to the control means 14. The confirmation signal merely communicates an informational content of one bit, i.e. does not contain any identifier or other particulars.

Other functionings of the local connection 40 are possible in alternative embodiments. For example, other electrical contacts between the base station 10 and the mobile part 12 can be employed instead of the charging contacts 24 and 38 via which the charging current for the mobile part 12 also flows, or an inductive, magnetic or optical connection can be utilized. More complex confirmation messages are employed in other alternative embodiments in order to further enhance the dependability.

When the confirmation is received at the base station 10 within a predetermined time span after the transmission of the data frame REG __ VAL REQ, this is recognized as event REG_VAL (event 80). When the confirmation does not arrive or arrives too late, the logon procedure is aborted.

As reaction to the event 80 (REG_VAL), the base station 10 sends a data frame REG_DATA (transmission event 82) that contains all required logon data via the radio connection 42. In the exemplary embodiment described here, these are the identifier, an index number of the mobile part 12, and two or more identifiers for those radio channels on which the future communication between the base station and the mobile part 12 should ensue. In alternative embodiments, further or other logon data can be transmitted.

When the mobile part 12 receives the data frame REG_DATA, it stores the communicated logon data in step 84. The identifier, which was generated by the mobile part in step 58, has hitherto been considered only as a provisional identifier. In step 84, it is now stored in the mobile part 12 as final, confirmed identifier.

The mobile part 12 confirms the correct reception of the logon data with a data frame REG___ACK that is transmitted to the base station via the radio connection 42 (transmission event 86). When, in contrast, the logon data do not arrive at the mobile part 12 within a predetermined time span, the logon is aborted. The mobile part 12 then outputs a negative acknowledgment tone.

The logon of the mobile part 12 in the base station 10 is completed in step 88. With the identifier that has now been confirmed, the mobile part 12 is entered in a logon list maintained by the control means 14. The successful termination of this event is acknowledged by the base station 10 with a data frame REG__COMP (transmission event 90). The date frame REG__COMP contains the identifier and is transmitted via the radio connection 42. The mobile part 12 signals the reception of this data frame with a positive acknowledgment tone in order to confirm the successful logon for the user. When, in contrast, the data frame REG__COMP does not arrive or arrives too late, the mobile part 12 generates a negative acknowledgment tone and erases the logon data stored in step 84.

Other configurations and time sequences of the communication protocol are possible in alternative embodiments of this method. In particular, more or fewer messages can be exchanged or the roles of the transmitters and receivers of these messages can be entirely or partially interchanged. Further, an adaptation of the method to communication systems other than mobile telephones is possible.